ORIGINAL RESEARCH

High Altitude Illness: Knowledge, Practice, and Attitudes of Porters in Nepal

Pranawa Koirala, MD, DiMM, DMEM; Seth E. Wolpin, PhD, MPH, RN, WEMT;
Janet T. Peterson, DrPH, NDTR, WEMT, FACSM

From the Department of Emergency Medicine, Virginia Tech Carilion Roanoke Memorial Hospital, Roanoke, VA (Dr Koirala); the Biobehavioral Nursing and Health Informatics, University of Washington, Seattle, WA (Dr Wolpin); and the Department of Health, Human Performance and Athletics, Linfield College, McMinnville, OR (Dr Peterson).

Introduction—Porters working at high altitude face a number of preventable health risks ranging from frostbite to potentially fatal high-altitude pulmonary and cerebral edema. Porters are often recruited from impoverished low-altitude areas, poorly equipped in terms of protective clothing, and tasked with carrying loads that equal or exceed their body mass to high elevations. Despite a large population of porters working throughout mountainous parts of the world, there is little documentation regarding knowledge levels, attitudes, and practices related to the prevention of altitude illness in this population. Much of the literature focuses on biomechanics of load carrying for porters or altitude issues for trekkers.

Methods—A cross-sectional survey was developed using a modified Delphi technique. The survey was administered to a convenience sample of porters (n=146) from diverse cultural groups between Lukla (2774 m) and Everest Base Camp (5361 m).

Results—Many of the porters started at a young age, carried heavy loads, and had difficulty identifying symptoms of high altitude illness, and less than 20% correctly identified preventive measures for high-altitude illness.

Conclusions—Porters in the Khumbu region continue to face hazards in their working environment. Future research and health education campaigns should address knowledge deficits and help with the design of tailored interventions.

Keywords: acute mountain sickness, underserved population, high altitude porters, porter's health, frostbite, pulmonary edema, cerebral edema

Background

Nepal ranks as one of the poorest countries in the world, with 55% of the population living below the international poverty line of US \$1.25 per day. In 2016, the gross national income per capita was \$730, and the average life expectancy at birth in 2015 was 70 y.¹ People originating from low-altitude areas may be drawn to work as a porter as an alternative to subsistence farming and as a means for providing an education for their children.² There are multiple risks

with working at high altitudes.³ With limited knowledge of altitude illness, limited access to health resources, few (or unenforced) work guidelines, economic pressures from family far away, limited protective clothing, and harsh weather conditions, porters face a figurative and literal uphill battle. Porters may ignore medical issues until they are incapacitated because they are not paid if they do not work, and they often do not have any form of health insurance.² In a study of workload trends of 2 high-altitude clinics in Nepal, it was noted that around 40% of patients seen at Pheriche aid post are Nepalese.⁴ Others have observed that many of these individuals are from low altitudes.⁵ Many of these porters originating from low altitudes have limited awareness of altitude illness or steps for prevention.²

Corresponding author: Pranawa Koirala, MD, Department of Emergency Medicine, Virginia Tech Carilion Roanoke Memorial Hospital, 379 Highland Ave. SW, Roanoke, VA 24016; e-mail: pranawakoira@gmail.com.

Submitted for publication November 2017.

Accepted for publication June 2018.

One group that has done a great deal of work on the ground in Nepal with porter education is the International Porter Protection Group (IPPG). There have been other education efforts as well, such as a Nepali language leaflet produced by Medex and the Mountain Medicine Society of Nepal.⁶ Although there are numerous published studies about porters in Nepal and altitude illness in the Khumbu, most are focused on the biomechanics of load carrying, pulmonary physiology at high altitudes, or risks for Western trekkers or climbers or are simple case reports.^{7–9} The purpose of our study was to add to the knowledge base and assess knowledge, practice, and attitudes regarding high-altitude illnesses among porters in the Khumbu valley of Nepal. The outcomes may also generalize to other vulnerable populations, such as high-altitude pilgrims.^{10,11}

Methods

The survey instrument was developed using a modified Delphi technique with an expert panel and 3 rounds of iterative development.¹² The questions were translated into Nepali and back-translated by a different translator into English. Differences were reconciled through dialogue with the translators. This study was approved by the Nepal Health research council ethical review board.

Surveys were verbally administered at 7 different locations along the Everest base camp trek between Lukla and base camp during October 2013. Two Nepali field assistants from the Sherpa community were trained to conduct the interviews in 2 commonly used languages of the area, Sherpa and Nepali. Surveys were most commonly administered while participants were resting on the trail or in porter shelters. One hundred and forty-six porters were approached and agreed to complete the survey. All porters approached completed the interview. A small gift (sun hat or a head scarf) was offered for participating in the survey. Although time to completion was not measured, it is estimated that surveys were completed in 15 min or less.

DATA ANALYSIS

A Nepali research assistant manually entered survey responses into Microsoft Excel 2010 (Redmond, WA) before import into IBM SPSS Statistics for Windows, version 23 (IBM Corp, Armonk, NY). Data analysis was conducted using frequency counts and measures of central tendency. We report data as mean $\pm$ SD with range as appropriate if normally distributed; otherwise, it is reported as median scores followed by the range. A *t* test was used to test for differences between perceived ability to carry weight above and below the village of Lukla.

Results

DEMOGRAPHICS

The median age for all participants was 26 (12–54) years. Seventy-two (53%) of the 146 porters were members of the Rai ethnic group. The remaining porters were Sherpa ($n=23$; 17%), Tamang ($n=24$; 18%), Chhetri ($n=6$), and Bishwakarma ($n=4$). Most participants reported their hometown and birthplace as the same location but were unable to report the associated altitude. Altitudes from reported village development committees (VDC) were used as a substitute measure. Following this approach, we found that the altitude of residence was 1890 ± 579 (400–4500) m ($n=130$). Sixty-one (42%) of participants reported that rice grows in their village, a common indicator for low vs high altitude. More than half ($n=81$; 56%) of the participants reported being married. Of the 81 participants who reported the number of children, the median was 2 (1–7). Over 41% ($n=34$) of porters with children had 3 or more. Although half of the participants ($n=73$; 51%) carried mobile phones, only a small percentage (4%) had smartphones. Forty-four of the participants (60%) reported using their phones to send text messages, particularly to other porters.

WORK

When not working as porters, 113 (80%) of the participants self-identified as farmers. An additional 21 (15%) reported that they were full-time students. Twenty-eight percent ($n=42$) started working as porters at age 15 y or younger (11–40). The number of months spent working as porters per year was 2.9 ± 2.6 (1–12).

Most jobs originated at Lukla ($n=104$; 71%), the gateway airport to the Everest region. Everest Base Camp was the most common destination ($n=52$; 41%). Most of the porters ($n=24$; 73%) reported that the load they were carrying was for a commercial agency (carrying goods and supplies for hotels, shops, construction, etc.) vs carrying personal belongings of trekkers. This is important because carrying the personal belongings of trekkers limits the rate of ascent. The median number of days per month that porters reported working was 20 (1–26). The porters surveyed reported carrying 35 ± 18 (6–102) kg. The maximum load ever carried was reported as 56 ± 18 (22–112) kg. Of the 143 participants who responded to this question, 127 (88%) indicated that their loads had not been weighed.

The number of days to destination from the start was 10 ± 7 (1–20). Porters reported being able to carry significantly more weight below Namche 57 ± 17 (30–115) kg compared with the weight they can carry above Namche 36 ± 15 (12–105) kg without injury (t (140) = 20.3; $P<0.001$).

SHELTER AND HEALTH

Of the 146 porters surveyed, 106 (74%) reported tea houses as the most frequent place for sleeping while working as a porter and 27 (19%) mentioned using porter shelters. Tea houses on the Everest Base Camp trekking route often consist of a single room where visitors can obtain food and drink. Oftentimes guests sleep in the same room on benches. Historically, many trekkers also used tea houses but most now stay in lodges, which are typically larger and have more amenities. It is not uncommon for a lodge to have more rudimentary sleeping quarters where porters may stay. Five (4%) reported sleeping in a lodge while travelling with trekking groups. In response to whether other people had inquired about their health, 83% (n=117) disagreed or strongly disagreed.

KNOWLEDGE REGARDING HIGH-ALTITUDE ILLNESS

Knowledge of symptoms

When asked to list some of the symptoms of high-altitude illness, 12% of the sample (n=17) were unable to identify a single symptom. The remaining participants could name at least 1 symptom, as seen in [Table 1](#). The most common symptom correctly identified was headache (n=110; 75%), which was closely followed by shortness of breath (n=37; 25%).

Knowledge of prevention of high altitude illness

The frequencies of high altitude illness (HAI) prevention strategies identified by the porters are reported in [Table 2](#). Ninety-two (63%) reported not knowing how to prevent HAI. Among those who indicated having knowledge to prevent HAI, the most common prevention strategy reported was drinking water (n=31; 21%) followed by ascending slowly (n=24; 16%) and drinking garlic soup (n=16; 11%). Only 5 (3%) mentioned acetazolamide (Diamox) as a means of preventing HAI.

Table 1. Frequencies of symptoms identified (n=146)

<i>Symptom</i>	<i>Frequency</i>
Headache	110 (75%)
Shortness of breath	37 (25%)
Vomiting	35 (24%)
Nausea	34 (23%)
Fatigue	16 (11%)
Sleep disturbances	6 (4%)
Do not know	17 (12%)

Table 2. Prevention strategy identified (n=146)

<i>Strategy</i>	<i>Frequency</i>
Drink water	31 (21%)
Ascend slowly ^a	24 (16%)
Drink garlic soup	16 (11%)
Take acetazolamide ^a	5 (3%)
Other	11 (8%)
Do not know	92 (63%)

^a An accepted high altitude illness prevention strategy.⁷

ILLNESSES AT WORK

High altitude illness

Fifty-seven participants (40%) reported experiencing at least 1 episode of HAI. Thirty-eight of these (67%) reported receiving help from a friend during the episode, 9 porters (16%) reported receiving help from trekkers, and 6 (10%) reported receiving no help at all. When asked what methods of treatment were used, 54 responses were received with 26 (48%) reporting that they went down on foot, and 12 (22%) were carried down on the back of another porter. Seven (13%) reported taking medicine, and 3 (6%) reported resting. Of the 142 porters who responded to the question, 39 (27%) reported that they continued to ascend with a headache and/or vomiting. One hundred and fifteen participants (81%) reported they have never taken acetazolamide.

Other illness

When asked what other illnesses they have experienced during working, 91 (62%) reported experiencing cough and cold symptoms, and 62 (42%) reported feeling very cold. Other common problems are listed in [Table 3](#). Few (n=8; 6%) described experiencing back problems. Of the 137 who responded to the question, 70 (51%) denied drinking alcohol while working as a porter. Those who drank reported consuming alcohol 4±2 (1–7) days per week. Forty-two (29%) of all respondents were smokers.

ATTITUDES ABOUT WORKING AS A PORTER, HAI, AND SCENARIO-BASED QUESTIONS

Most (94%) of the porters surveyed reported that they were not happy working as a porter. Seventy-four percent (n=104) agreed that they would not be hired again if they had HAI. Most porters surveyed (90%) wanted more education about HAI. A minority of porters reported having adequate clothing (45%) and shoes (35%) for their work, and only 17% (n=24) agreed that

Table 3. Additional symptoms experienced while portering (n=146)

Symptom	Frequency
Cough	91 (62%)
Feeling cold ^a	62 (43%)
Fever	28 (19%)
Foot problems	18 (12%)
Frostbite	11 (8%)
Back pain	8 (6%)
Stomach problems	8 (6%)
Trauma (cuts/injuries)	7 (5%)
Snow-blind/Vision	5 (3%)

^a The survey indicated hypothermia. The participants were asked about feeling cold.

other people inquire about their health or wellbeing. The responses to attitudinal questions are found in Table 4.

Porters were also asked how they would respond in different scenarios or compared with other groups. The purpose of these questions was to investigate the knowledge and attitudes of the porters in response to serious situations. When asked about having signs and symptoms of HAI at Namche (3450 m), 77 (54%) indicated that they would wait until the symptoms resolved, 41 (29%) indicated that they would descend immediately, and 17 (12%) reported that they would confer with their trek leader. Six porters (4%) indicated that they would

Table 4. Attitudinal questions and responses

Question	Agree or strongly agree (n=142)
I am not at risk for AMS	46 (32%)
If I get a headache, I should not go any higher	130 (92%)
I am happy working as a porter	9 (6%)
If I get sick from AMS, my boss will not hire me again	104 (73%)
I am carrying too much weight for my health	40 (28%)
We need more education for porters about AMS	126 (90%)
I feel pressure to go faster	23 (16%)
I feel pressure to carry more weight	16 (11%)
The places I sleep are clean and comfortable	50 (35%)
Other people often enquire about my health	24 (17%)
My clothing is adequate for my work	64 (45%)
It is common for porters to drink alcohol while they are carrying	63 (44%)
AMS can kill me	132 (94%)
My shoes are adequate for my work	50 (35%)

AMS, acute mountain sickness.

These data were reported as a 4-point Likert scale.

continue their ascent. When asked a similar question with more severe symptoms and with the onset of symptoms at a higher elevation (Machermo, 4410 m), nearly all 139 (99%) indicated that they would wait until there is daylight and then descend to lower altitude. When asked who was more likely to get an HAI, porters or trekkers, the porters indicated that the trekkers were most likely (53%), followed by equal chances (27%), and then the porters (10%).

Discussion

The high frequency of porters in our study who reported not knowing how to prevent HAI does not support the findings of a past study surveying 92 porters, which concluded that the majority recognized the symptoms of altitude illness and the most appropriate action.¹² These findings support the need for education and suggest more work is needed to accurately measure knowledge deficits. Similar to previous reports, 40% of the porters in the current study reported experiencing at least 1 episode of HAI. This may not reflect the actual number because reporting HAI may be minimized as it can be a sign of weakness and result in fewer work offers. More concerning is the high rate of evacuation on another porter's back, which signifies the possibilities of severe HAI, lack of adequate emergency medical response services, and potential injury to the rescuer. Previous observations with other vulnerable groups such as pilgrims and yarsagumba pickers at high altitude noted that they often delay seeking medical attention due to low levels of education and awareness regarding high-altitude illnesses.^{11,13} Many porters reported having continued ascending despite experiencing headache and vomiting. Of additional concern was that nearly three quarters of the porters believed that if they got HAI, they would endanger their chances of being hired again. This points toward the financial pressure driving their health vulnerability, as with the yarsagumba pickers, another vulnerable population in Nepal.¹¹

The most commonly reported HAI prevention strategy of hydration has not been recognized as effective.^{14,15} Most popular literature suggests maintaining adequate hydration for HAI prophylaxis. Another area of concern was the high rate of reporting feeling very cold. This finding is supported by the substandard clothing observed during the data collection period and the self-report of inadequate clothing by the participants.

About 19% of the responders reported starting working as porter at age 14 or younger, with the youngest being 11 y. The child labor prevalence in population in this age group is 34% in Nepal.^{16,17} The average weight carried by trekking porters was in line with guidelines of 30 kg recommended by the IPPG, an international

advocacy group; however, many reported carrying heavier loads. This supports reports that guidelines are not properly regulated—especially with regard to weight restrictions.² A majority of the participants during this study indicated that their load was not weighed. With no limits on how much weight is carried, some porters carry very heavy loads, which may be detrimental to their health. Anecdotally, trekking porters have been observed requesting “double loads” so that they can double their income. These findings support the research of others. In one study, researchers set up a weigh station between Lukla and Namche at 2800 m. In a single day, they counted 545 male and 97 female porters and randomly selected 113 for measurements of loads, finding that the average load was 89% of their body weight.⁹ Another study reports meeting a man in his early 20s, weighing under 50 kg, who was carrying a load close to 150 kg—a load so heavy the head strap had cut into his skin.² These large loads result in excessive physical exertion, which may be detrimental to acclimatization.

STUDY LIMITATIONS

The inability to accurately determine the altitude of the porter's residence is a limitation. Many porters did not know the altitude of their village, nor could their villages be found on a map. We used the VDC altitude as a substitute, but this variable is of questionable value because altitudes differ within a VDC, sometimes by considerable magnitude. One suggestion is to make the variable dichotomous and to simply ask participants if they grew up higher or lower than known places like Lukla or Jiri. Previous researchers have stratified low and high altitude by asking subjects if they resided in a place where rice grows, noting that it does not readily grow above 3050 m.^{12,18} Some of the variables in this study were not operationally defined well, leading us to realize later that multiple interpretations of the survey item could have occurred or that our measurement scale was incorrect. These variables were removed from the analysis. This study also relied on self-report, and this may have led to response biases that could have confounded the results. It may be prudent to assess recent trips to high altitude for better understanding of their acclimatization. Furthermore, the study took place in one area in Nepal, limiting our ability to generalize to other geographic areas and ethnic groups.

Conclusion

The preliminary results from this study build on prior research and add new information about the health of porters at high altitude. Porters in the Khumbu region continue to face hazards in their working environment. Future research and health education campaigns should

address knowledge deficits and help with the design of tailored interventions.

Acknowledgments: Thank you to the following members of the expert panel for the survey and development: Dr Luanne Freer, Dr Kami Temba Sherpa, Dr Tshering Wangi Sherpa, Mr Ngawang Dorjee Sherpa, Dr Andrew Luks, and George Rodway. Thanks to Archana Shrestha for data analysis and entry. Also, thanks to Biraj Karmacharya and Dr Ojashwi Nepal for IRB application. Special thanks to Nepal Health research council and the Kathmandu Medical University at Dhulikhel for review and expert input on the study. We thank the citizen group of researchers. Thank you to Dorjee Sherpa, Pasang Sherpa, and Nima Sherpa for help in administering surveys. Special thanks to Mountain Khakis and Nomad Clinical Research for their generous donations of hats and buffs for the porters. And finally, thanks to all the porters who completed our survey.

Author Contributions: Concept of the study (SW, JP); acquisition of the data (JP); data analysis (JP, PK); drafting of manuscript (PK); revision of the manuscript (SW, JP, PK).

Financial/Material Support: None.

Disclosures: None.

References

1. The World Bank. *The Little Data Book 2016*. Washington, DC: The World Bank Group; 2016.
2. Law A, Rodway GW. Trekking and climbing in the Solu-Khumbu district of Nepal: impact on socioeconomic status and health of lowland porters. *Wilderness Environ Med*. 2008;19(3):210–7.
3. Subedi BH, Pokharel J, Thapa R, Banskota N, Basnyat B. Frostbite in a Sherpa. *Wilderness Environ Med*. 2010;21(2):127–9.
4. Basnyat B, Savard GK, Zafren K. Trends in the workload of the two high altitude aid posts in the Nepal Himalayas. *J Travel Med*. 1999;6(4):217–22.
5. Martindale MR. Another night at the Himalayan Rescue Association aid post in Pheriche, Nepal: the porter who fell 300 m. *High Alt Med*. 2007;8(3):253–5.
6. Medex. *Travel at High Altitude*. 2008. Available at: medex.org.uk. Accessed August 24, 2018.
7. Bellis F, Parris R, Thake D, Richards P. Difficult decisions at altitude: the management of an acutely dyspneic porter at 5000 meters. *Wilderness Environ Med*. 2005;16(4):212–8.
8. Basnyat B, Litch JA. Medical problems of porters and trekkers in the Nepal Himalaya. *Wilderness Environ Med*. 1997;8(2):78–81.
9. Schepens B, Basnyat B. The burden of the Himalayan porter. *High Alt Med Biol*. 2001;2(2):315–7.
10. Bhandari SS, Koirala P. Health of high altitude pilgrims: a neglected topic. *Wilderness Environ Med*. 2017;28(3):275–7.
11. Koirala P, Pandit B, Phuyal P, Zafren K. Yarsagumba fungus: health problems in the Himalayan gold rush. *Wilderness Environ Med*. 2017;28(3):267–70.
12. Newcomb L, Sherpa C, Nickol A, Windsor J. A comparison of the incidence and understanding of altitude illness between porters and trekkers in the Solu Khumbu region of Nepal. *Wilderness Environ Med*. 2011;22(3):197–201.

13. Zafren K, Pun M, Regmi N, Bashyal G, Acharya B, Gautam S, et al. High altitude illness in pilgrims after rapid ascent to 4380 m. *Travel Med Infect Dis*. 2017;16:31–4.
14. Basnyat B, Murdoch DR. High-altitude illness. *Lancet*. 2003;361(9373):1967–74.
15. Nerin MA, Palop J, Montano JA, Morandeira JR, Vazquez M. Acute mountain sickness: influence of fluid intake. *Wilderness Environ Med*. 2006;17(4):215–20.
16. UNICEF. Nepal: Statistics. Available at: https://www.unicef.org/infobycountry/nepal_nepal_statistics.html. Accessed September 25, 2017.
17. Doocy S, Crawford B, Boudreaux C, Wall E. The risks and impacts of portering on the well-being of children in Nepal. *J Trop Pediatr*. 2007;53(3):165–70.
18. Paudel MN. Rice (*Oryza sativa* L) cultivation in the highest elevation of the world. *Agron J Nepal*. 2011;2:31–41.